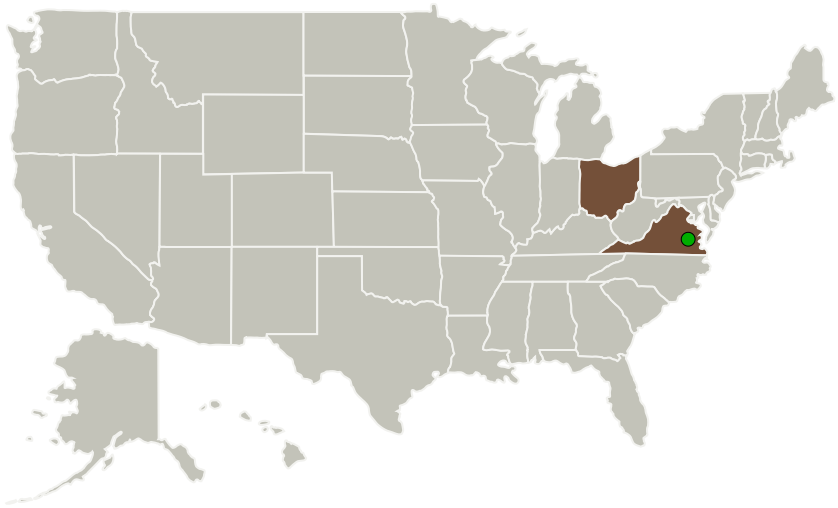
Development of Wavelet Stochastic Estimation for Identifying the Contribution of Turbulent Structures to the Sound Field of Shear Flows, Phase I

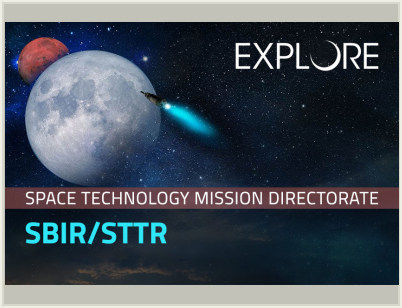
Completed Technology Project (2011 - 2011)

Project Introduction

Fundamental understanding of noise generation and the development of noise reduction technology requires the development of tools that can analyze simultaneously the relationship between the turbulent flow field and the pressure field both near and far. In this proposal we will demonstrate how Wavelet Stochastic Estimation (WSE) is the most optimal method for correlating the source region to the sound field when using a microphone array and Particle Image Velocimetry. WSE first transforms the far-field pressure signal into the wavelet domain which then enables both temporal and frequency information to be correlated with the flow field. By adding the frequency information to the correlations, it becomes easier to extract the contribution from the large-scale structures and thus relate their dynamics to noise generation. We also demonstrate how WSE can be used with flow structure identification methods, such as the Proper Orthogonal Decomposition (POD), to further improve the link between the sound field and the turbulent flow field. The proposed technology supports the Fundamental Aeronautics Program by improving noise prediction and measurement methods. The technology will be available for both subsonic and supersonic vehicles, with particular emphasis on noise sources generated from shear flows.

Primary U.S. Work Locations and Key Partners





Development of Wavelet Stochastic Estimation for Identifying the Contribution of Turbulent Structures to the Sound Field of Shear Flows, Phase I

Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Project Transitions	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Technology Areas	3
Target Destinations	3

Development of Wavelet Stochastic Estimation for Identifying the Contribution of Turbulent Structures to the Sound Field of Shear Flows, Phase I

Completed Technology Project (2011 - 2011)

Organizations Performing Work	Role	Type	Location
Spectral Energies, LLC	Lead Organization	Industry Small Disadvantaged Business (SDB)	Dayton, Ohio
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Ohio	Virginia

Project Transitions

February 2011: Project Start

September 2011: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138097)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Spectral Energies, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

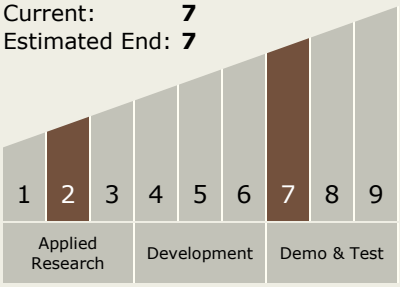
Carlos Torrez

Principal Investigator:

Sivaram Gogineni

Technology Maturity (TRL)

Start: **2**
Current: **7**
Estimated End: **7**



Development of Wavelet Stochastic Estimation for Identifying the Contribution of Turbulent Structures to the Sound Field of Shear Flows, Phase I

Completed Technology Project (2011 - 2011)

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.4 Aeroacoustics

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System